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Case Docket No. 4648 US

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Deposited July 31, 2000

THE COMMISSIONER OF PATENTS AND TRADEMARKS

Washington, D.C. 20231



Sir:

This a request for an application under 37 CFR 1.53(b) and (f)

Transmitted herewith for filing is the patent application of

Inventor(s) Manfred Hähl

For: COLOR HEAD-UP DISPLAY, IN PARTICULAR FOR A VEHICLE

Enclosed are:

- ☒ 10 pages, abstract, specification, and claims; unsigned declaration (1 page)
- ☒ 3 soft 8.5"x11" size sheets of drawings (Figs. 1-4) attached to application
- ☒ Filing without fee or Declaration under 37 CFR 1.53(f)
- ☒ Express Mail mailing label no. on all filed papers
- ☐ certified copies of a German Patent Application
- ☒ Preliminary Amendment (PLEASE ENTER BEFORE CALCULATING CLAIM FEES)
- ☐ Information Disclosure Statement,

Claims as Filed

	NUMBER FILED	NUMBER EXTRA	RATE	BASIC FEE \$690.00
TOTAL CLAIMS	15 -20=	0	\$18	0
INDEPENDENT CLAIMS	1 -3=	0	\$78	0
Surcharge fee for filing under 1.53(f)				\$130.00
				\$820.00

- ☒ CLAIM IS HEREBY MADE OF THE BENEFIT OF THE FILING DATE OF THE German Patent Application: 100 16 817.5 filed April 5, 2000 UNDER 35 USC 119.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Express Mail mailing Label No. EJ450234355US
Deposited July 31, 2000

USA Patent Application
Manfred Hähl
COLOR HEAD-UP DISPLAY, IN
PARTICULAR FOR A VEHICLE

Priority: German Patent Application
100 16 817.5 April 5, 2000

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

S I R :

PRELIMINARY AMENDMENT

Please amend this application simultaneously with filing as
follows:

IN THE ABSTRACT

UNNUMBERED PAGE 10

Line 5, delete "it is provided that"

Last line on page, delete "(Fig. 1)"

IN THE SPECIFICATION

PAGE 1

Line 7, delete "Description"

Line 11, before this line, after the title, insert:

--FIELD AND BACKGROUND OF THE INVENTION--

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Line 37, before this line insert:

--SUMMARY OF THE INVENTION--

PAGE 4

Line 7, before this line insert

--BRIEF DESCRIPTION OF THE DRAWINGS--

Line 8, after "figures" insert --of the drawings-- and delete
the colon ":"

Line 20, before this line insert:

--DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT--

IN THE CLAIMS

(APPLICATION PAGES 8-9)

Before claim 1, change "Patent Claims" to --I CLAIM:--

Please amend claims 1-15 as follows:

1. (amended) A color head-up display, in particular for vehicles, in which the light from a light source (2) is transmitted through an at least partially light-transmitting display (3) and [can be projected] is projectable onto a windshield, **wherein** a multiplicity of red, blue and green

light-emitting diodes (10 - 12) are arranged without packaging on a common support (16, 17, 19), and wherein a heat-dissipating device (19) for cooling the light-emitting diodes is present.

2. (amended) The color head-up display as claimed in claim 1, **wherein** [the] said multiplicity of light-emitting diodes (10, 11, 12) is arranged in the form of a compact array.

3. (amended) The color head-up display as claimed in claim 2, **wherein** [the] said compact array is configured in the form of a matrix.

4. (amended) The color head-up display as claimed in claim 1 [one of the preceding claims], **wherein** the number of light-emitting diodes of one color is adapted to the spectral sensitivity of the eye and to the spectral efficiency of the diodes.

5. (amended) The color head-up display as claimed in claim 2 [one of the preceding claims], **wherein** the compact array has a largely round form.

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6. (amended) The color head-up display as claimed in claim 1 [one of the preceding claims], **wherein** the individual light-emitting diodes (10, 11, 12) are [configured as] chip pads fitted on a metallic support material array (9).

7. (amended) The color head-up display as claimed in claim 6, **wherein** in each case at least one bonding wire (15) is connected to [the] said chip pad (10, 11, 12) and to the support material array (9).

8. (amended) The color head-up display as claimed in claim 1 [one of the preceding claims], **wherein** a plurality of said light-emitting diodes (10, 11, 12) are connected in series.

9. (amended) The color head-up display as claimed in claim 8, **wherein** a plurality of said light-emitting diodes (10, 11, 12) of one color are connected in series.

10. (amended) The color head-up display as claimed in claim 1 [one of the preceding claims], **wherein** the at least partially light-transmitting display (3) is [configured as] a liquid crystal display.

11. (amended) The color head-up display as claimed in claim 10, **wherein** [the] said display (3) is a color liquid crystal display, and wherein the light source (2) simultaneously emits red, green and blue light.

12. (amended) The color head-up display as claimed in claim 10, **wherein** [the] said liquid crystal display (3) is a monochrome liquid crystal display, and wherein the individual colors of the light-emitting diodes [can be] are successively [switched] switchable on and off in a rapid sequence.

13. (amended) The color head-up display as claimed in claim 1 [one of the preceding claims], **wherein** a condenser lens (7) is arranged between the light source (2) and the display (3).

14. (amended) The color head-up display as claimed in claim 1 [one of the preceding claims], **wherein** light from the light-emitting diode (10 - 12) is reflected by [means of] one or a plurality of mirrors and is transmitted through the display (3).

15. (amended) The color head-up display as claimed in claim 1 [one of the preceding claims], **wherein** [it

has] there are one or a plurality of displays (3) and a plurality of said light sources (2).

R E M A R K S

This amendment is being made simultaneously with filing this application. The abstract, specification and claims 1-15 have been amended in accordance with USA practice under 35 USC 112 and to eliminate multiple-dependent form claims. No multiple-dependent claims exist as of the filing date.

No multiple-dependent form claims exist in this application.

Please enter this Preliminary Amendment prior to calculating the claim filing fee and prior to an action on the merits.

Respectfully submitted,

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No. EJ450234335US

Description Filed July 31, 2000

Color head-up display, in particular for a vehicle

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The invention relates to a color head-up display, in particular for a vehicle.

15 The prior art discloses color head-up displays having a wide variety of light sources, such as, for example, fluorescent lamps or halogen lamps, in which the light from the light source is transmitted through an at least partially light-transmitting display and can be projected onto a windshield. Halogen lamps have the disadvantage of a relatively short durability
20 (approximately 500 - 1000 operating hours). Due to the installation position in head-up displays in motor vehicles, the lamps can be changed only by trained specialist personnel. In the case of fluorescent lamps, only a small part of the light energy can be used for
25 illumination owing to the geometrical dimensions of the fluorescent lamp and the small usable region for a head-up display optical arrangement.

Furthermore, motor vehicle head-up displays require the light source to have a large dimming range,
30 since the ambient brightness around the motor vehicle varies greatly depending on the time of day and the surroundings. Since the spectral properties of halogen and fluorescent lamps alter when the latter are dimmed, color-neutral dimming is possible at best with a high
35 structural complexity with a corresponding space requirement.

The object of the invention, therefore, is to specify a color head-up display which is constructed compactly and can be dimmed in a wide range.

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This object is achieved by virtue of the fact that a multiplicity of red, green and blue light-emitting diodes are arranged without packaging on a common support, and that a heat-dissipating device for cooling the light-emitting diodes is present. By dispensing with the otherwise customary packaging (housing of the light-emitting diodes), it is possible to arrange the individual light-emitting diodes very close together. A high luminance is achieved as a result of this, said luminance being required in order to transilluminate the display so that an optimum optical representation is obtained even under bright daylight conditions. The cooling device then protects the light-emitting diodes - arranged very close together - against thermal overloading.

The multiplicity of light-emitting diodes may be arranged in the form of a compact array. The compact array may be configured as a matrix, for example. This enables the bonding of the individual diodes to be carried out in a simple manner. It is also possible, for example, to configure the arrangement of the diodes in a spiral form or in the form of concentric circles lying one inside the other.

By virtue of the fact that the number of light-emitting diodes of one color is adapted to the spectral sensitivity of the eye and to the spectral efficiency of the diodes, the individual light-emitting diodes can be fully utilized for full desired luminous intensity in a specific hue, in particular for white light, since the different colors then cause an observer to experience approximately the same sensation of brightness and dimming of one or more color groups is not necessary, or is only necessary to a slight extent, in order to obtain the desired hue (in particular for desired white light).

By virtue of the fact that the compact array largely has a round form, the luminous intensity of the light-emitting diodes that are present can be fully utilized if the light is transmitted through a lens

optical arrangement. In this way, material and, in particular, energy are saved and thus the evolution of heat by the light-emitting diodes is also reduced to the necessary extent.

5 The configuration of the compact array is particularly simple if the light-emitting diodes are configured as chip pads which are each applied on a metallic support material array and a connection of the light-emitting diode is electrically conductively
10 connected thereto. In the case described above, the light-emitting diode can be supplied with electrical energy in a particularly simple manner if in each case one bonding wire is connected to the light-emitting diode and a further bonding wire is connected to the
15 metallic support material array. This configuration makes it possible to realize a simple series circuit of a plurality of light-emitting diodes if the diodes which are simultaneously adjacent to the support material arrays are electrically insulated from one
20 another.

By virtue of the fact that a plurality of light-emitting diodes are connected in series, the integrated circuit requires fewer external connections. Moreover, the risk of hot spots of individual light-
25 emitting diodes is greatly reduced.

By virtue of the fact that a plurality of light-emitting diodes of one color are connected in series, the different colors can be dimmed differently and so a variety of colors can be represented with at
30 the same time few external connections being required.

The use of a color liquid crystal display as the light-transmitting display in the abovementioned head-up displays enables a simple color representation, in particular when, in the case of the light source,
35 the differently colored light-emitting diodes are driven in such a way that the light source emits white light.

The use of a monochrome liquid crystal display as the light-transmitting display in a head-up display

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with the light source described above requires only a simple liquid crystal display yet allows a color representation if the individual colors of the light-emitting diodes can be successively switched on and off in a rapid sequence and the observer receives a composite image on account of the inertia of his eyes.

The invention is explained in more detail below with reference to the figures, in which:

Figure 1 shows an exemplary embodiment of a head-up display according to the invention in a motor vehicle.

Figure 2 shows the plan view of a particularly preferred example of a light source according to the invention.

Figure 3 shows a partial section through a particularly preferred example of a light source according to the invention.

Figure 4 shows the representation of a head-up display with a divided light source.

Figure 1 shows a basic illustration of a partly sectional side view of a head-up display used in a motor vehicle 1. This head-up display comprises a light source 2, a condenser lens 7, a liquid crystal display 3, a lens optical arrangement 4 and a projection region 5 on a front windshield 6 of the motor vehicle 1. The effect of the condenser lens 7 is that as much light as possible from the light source 2 reaches the liquid crystal display 3. A good light utilization factor can also be achieved e.g. by arranging the light source 2 in a concave mirror in such a way that virtually all the light rays emitted by the light source 2 pass directly or through reflection in the direction of the liquid crystal display 3. The liquid crystal display 3 is configured for example as a dot matrix on which an arrow is represented in the example. The light from the light source 2 is concentrated by the condenser lens 7, passes through the liquid crystal display 3 and is projected through the lens optical arrangement 4 onto the projection region 5 of the front windshield 6. A

driver D of the motor vehicle 1 can thus perceive an arrow 8 with the remaining surroundings (not illustrated) in front of the vehicle. The lens optical arrangement 4 may also be dispensed with, depending on the arrangement of the light source 2, the display 3, the projection region 5 and, possibly, the condenser lens 7 or the concave mirror (not illustrated).

The plan view of a particularly preferred exemplary embodiment of a particularly preferred light source 2 in Figure 2 shows support material arrays 9, on which light-emitting diodes 10, 11, 12 are arranged in the form of chip pads and are electrically conductively connected to the support material arrays 9. The support material arrays 9 are DC-isolated from the support material arrays 9 that are adjacent to them by means of trenches 13 and are arranged in matrix form. The light-emitting diodes bearing the reference symbols 10 are red, those bearing the reference symbols 11 are blue and those bearing the reference symbols 12 are green. In each case a plurality of light-emitting diodes 10, 11, 12 of a respective color are connected in series in such a way that a bonding wire 15 is connected either to the LED chip pad 10, 11, 12 or to the support array 9. In this case, it is always a plurality of light-emitting diodes of one color which are connected in series. The respective end of the series is led to external connections R, G, B, the external connection R being connected to red light-emitting diodes, the external connection G being connected to green light-emitting diodes and the external connection B being connected to blue light-emitting diodes. By following the bonding wires starting at the external connections R, G, B, it can be seen that, of the 69 light-emitting diodes 10, 11, 12 illustrated, 19 are red light-emitting diodes 10, 16 are blue light-emitting diodes 11 and 34 are green light-emitting diodes 12. The comparatively high number of green light-emitting diodes 12 relative to the red and blue light-emitting diodes 10, 11 is due to the

fact that the human eye perceives mixed light to be white when the light has a particularly high proportion of green light relative to low proportions of red and blue light.

5 It can be seen, moreover, that the arrangement of the light-emitting diodes 10, 11, 12 forms virtually a circular area. Light-emitting diodes outside this circular area would only increase the energy consumption and the evolution of heat without
10 significantly improving the luminous efficiency if the light is transmitted through the condenser lens 7 illustrated in Figure 1. A circle which can completely enclose the circular area may, for example, have a diameter of 6 millimeters. In the example illustrated,
15 the edge lengths of the support arrays 9 are approximately 600 μm , those of the red light-emitting diode chip pads 10 are approximately 250 μm and those of the blue and green light-emitting diode chip pads 11, 12 are approximately 310 μm in each case. However,
20 other dimensions are also conceivable. The light source 2 attains the required luminance as a result of the small diameter of the circular area and the high number of light-emitting diodes (69 in the present example). The configuration of the circular area could also be
25 realized for example by arranging the adjacent diodes in the form of concentric circles lying one inside the other, or in the form of a spiral.

 The partial section through a light source 2 as illustrated in Figure 3 reveals the light-emitting
30 diodes 10, 11, 12 in the form of chip pads which are electrically conductively connected to metallic support material arrays 9 and are arranged on the latter. The support material arrays 9 are arranged on a thermally conductive electrical insulation layer 16. Beneath the
35 insulation layer 16 there is additionally a further thermally conductive electrical insulation layer 17, for example made of silicon or ceramic, which is thermally conductively connected to a copper support 19, for example by means of a conductive adhesive or a

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soldering layer 18. The copper support 19 is simultaneously used for the purpose of uniform heat distribution in the light source 2 and thus for cooling purposes as well. The support 19 may also be produced from another material that is a good conductor of heat, and/or be connected to a heat sink.

By way of example, cooling of the light source 2 may also be realized by a fan or by a Peltier element.

10 In Figure 4, there are two light sources 2,
which irradiate a respective display 3 via a respective
condenser lens 7. This arrangement is expedient
particularly when the height and width of the
respectively desired display array 5 differ greatly
15 from one another. The light from the light-emitting
diodes that are present is thus better utilized.
Furthermore, fewer problems arise on account of
distortion, or distortion suppression can be realized
more easily. It is also possible for a single display 3
20 to be irradiated by a plurality of light sources 2.

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Patent claims

1. A color head-up display, in particular for
10 vehicles, in which the light from a light source (2) is
transmitted through an at least partially light-
transmitting display (3) and can be projected onto a
windshield, **wherein** a multiplicity of red, blue and
15 green light-emitting diodes (10 - 12) are arranged
without packaging on a common support (16, 17, 19), and
wherein a heat-dissipating device (19) for cooling the
light-emitting diodes is present.
2. The color head-up display as claimed in claim
1, **wherein** the multiplicity of light-emitting diodes
20 (10, 11, 12) is arranged in the form of a compact
array.
3. The color head-up display as claimed in claim
2, **wherein** the compact array is configured in the form
of a matrix.
- 25 4. The color head-up display as claimed in one of
the preceding claims, **wherein** the number of light-
emitting diodes of one color is adapted to the spectral
sensitivity of the eye and to the spectral efficiency
of the diodes.
- 30 5. The color head-up display as claimed in one of
the preceding claims, **wherein** the compact array has a
largely round form.
6. The color head-up display as claimed in one of
the preceding claims, **wherein** the individual light-
35 emitting diodes (10, 11, 12) are configured as chip
pads fitted on a metallic support material array (9).
7. The color head-up display as claimed in claim
6, **wherein** in each case at least one bonding wire (15)

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is connected to the chip pad (10, 11, 12) and to the support material array (9).

8. The color head-up display as claimed in one of the preceding claims, **wherein** a plurality of light-emitting diodes (10, 11, 12) are connected in series.

9. The color head-up display as claimed in claim 8, **wherein** a plurality of light-emitting diodes (10, 11, 12) of one color are connected in series.

10. The color head-up display as claimed in one of the preceding claims, **wherein** the at least partially light-transmitting display (3) is configured as a liquid crystal display.

11. The color head-up display as claimed in claim 10, **wherein** the display (3) is a color liquid crystal display, and wherein the light source (2) simultaneously emits red, green and blue light.

12. The color head-up display as claimed in claim 10, **wherein** the liquid crystal display (3) is a monochrome liquid crystal display, and wherein the individual colors of the light-emitting diodes can be successively switched on and off in a rapid sequence.

13. The color head-up display as claimed in one of the preceding claims, **wherein** a condenser lens (7) is arranged between the light source (2) and the display (3).

14. The color head-up display as claimed in one of the preceding claims, **wherein** light from the light-emitting diode (10 - 12) is reflected by means of one or a plurality of mirrors and is transmitted through the display (3).

15. The color head-up display as claimed in one of the preceding claims, **wherein** it has one or a plurality of displays (3) and a plurality of light sources (2).

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Abstract

Color head-up display, in particular for a vehicle

In a color head-up display, in particular for vehicles, in which the light from a light source (2) is transmitted through an at least partially light-transmitting display (3) and can be projected onto a windshield, it is provided that a multiplicity of red, blue and green light-emitting diodes are arranged without packaging on a common support, and that a heat-dissipating device for cooling the light-emitting diodes is present.

(Fig. 1)

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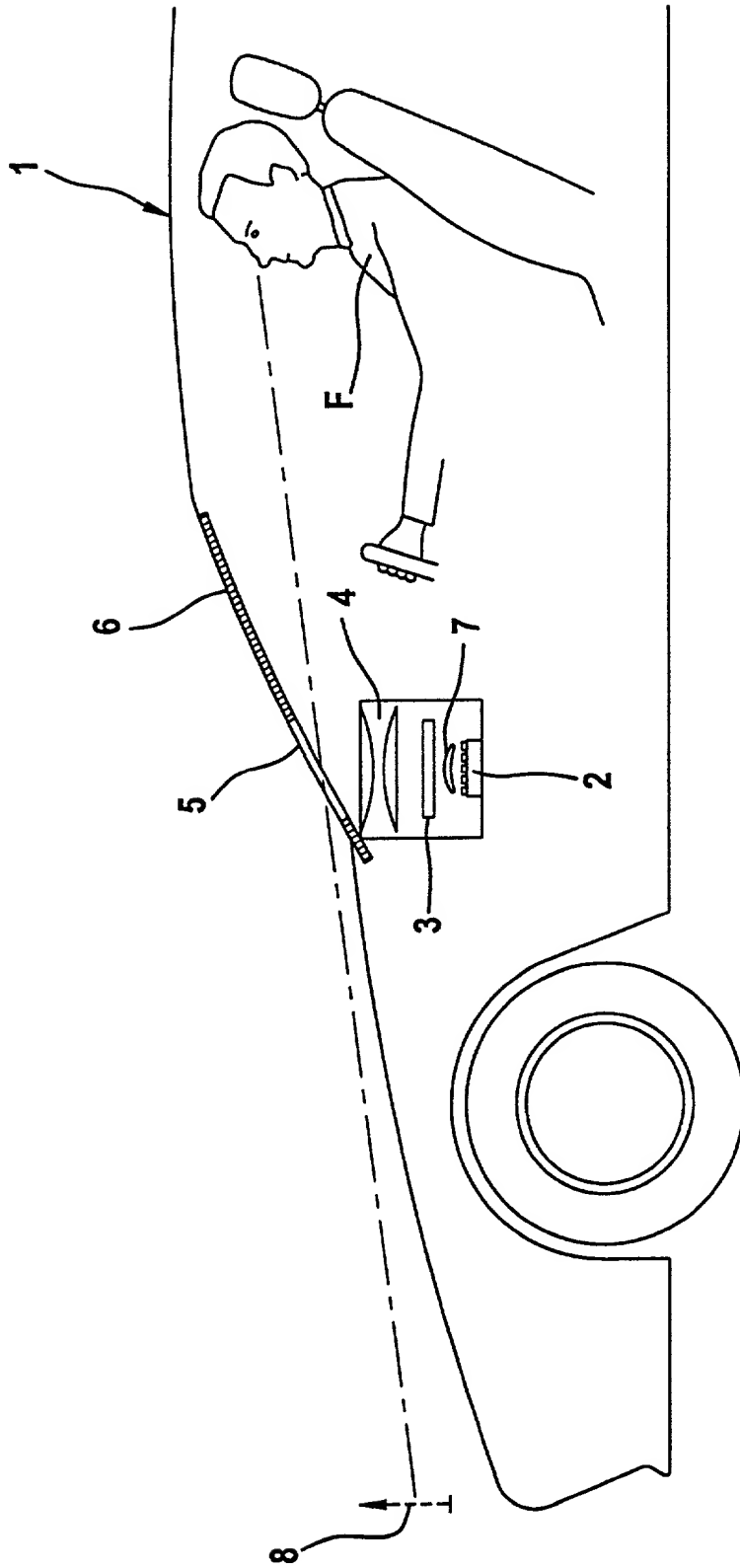


Fig. 1

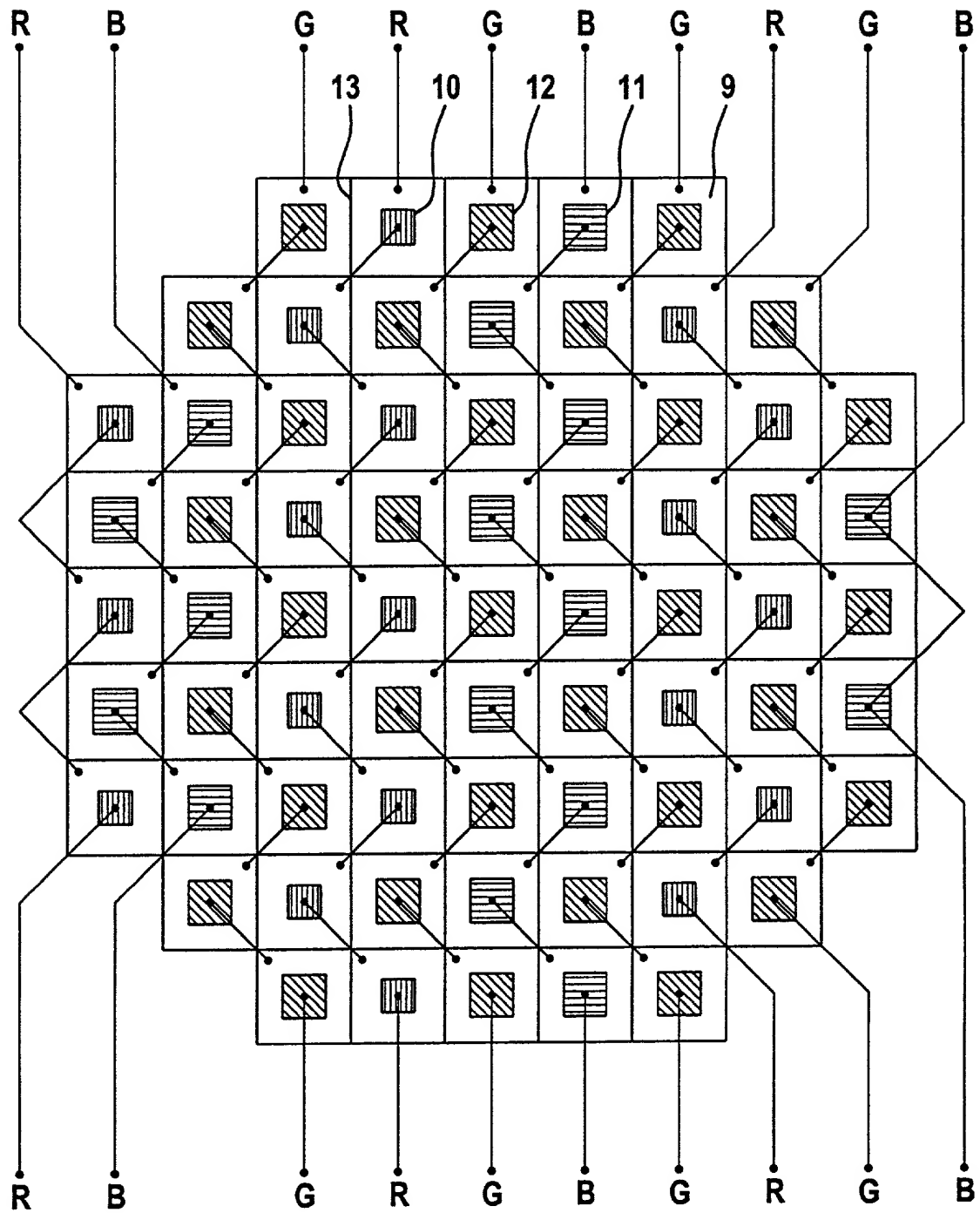


Fig. 2

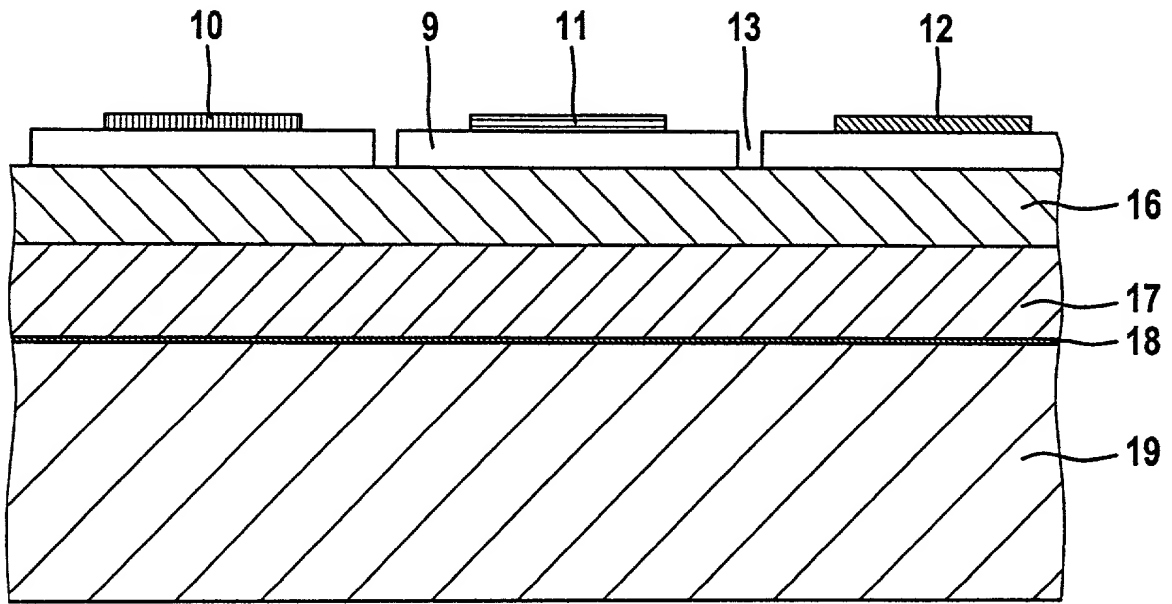


Fig. 3

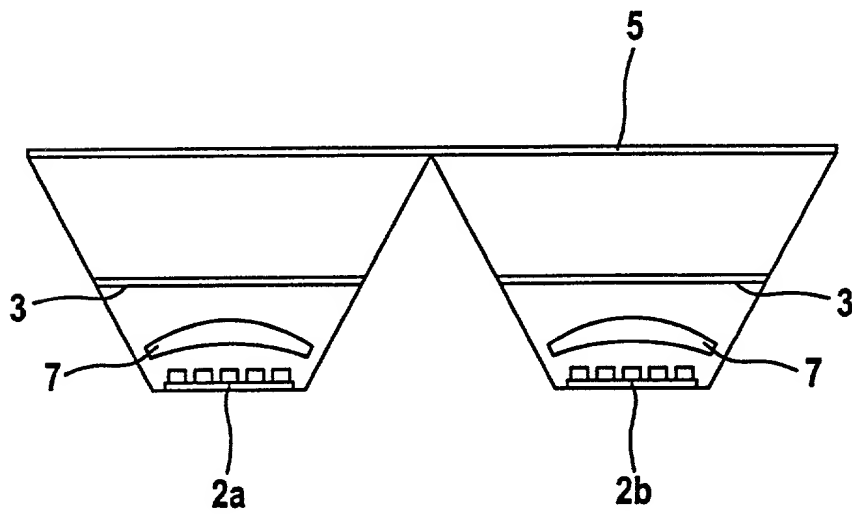


Fig. 4

DECLARATION FOR PATENT APPLICATION

Docket Number (Optional)

4648 US

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled COLOR HEAD-UP DISPLAY, IN PARTICULAR FOR A VEHICLE, the specification of which

is attached hereto unless the following box is checked:

☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

<u>100 16 817.5</u>	<u>Germany</u>	<u>05/04/2000</u>	Priority Claimed
(Number)	(Country)	(Day/Month/Year Filed)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No
(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No
(Number)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

_____	_____	_____
(Application Number)	(Filing Date)	(Status -- patented, pending, abandoned)

_____	_____	_____
(Application Number)	(Filing Date)	(Status -- patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Full name of second joint inventor, if any (given name, family name) _____
 Second inventor's signature _____ Date _____
 Residence _____ Citizenship _____
 Post Office Address _____

☐ Additional inventors are being named on a separate sheet attached hereto.